BULLETIN

OF THE

Society for the Promotion of Engineering Education

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EDITORIALS.

The Training of Engineering Teachers.—After reading the papers on the training of teachers printed elsewhere in this issue of the BULLETIN, one is apt to ask himself why the importance of the subject is, apparently, just coming to be realized. Certainly past practice has been based on the assumption that the prime requisite for good teaching is a knowledge of the subject to be taught.

The suggestion of a course in pedagogy for an engineering teacher would be received with a smile. Such is for school teachers, not for engineering instructors with their engineering degrees and their practical experience. And yet their

training was designed to make them engineers not teachers. As has been pointed out many times, most instructors in engineering subjects look upon their occupation as temporary. They will teach for a year or two to get a better grounding in fundamentals and to have a little opportunity for graduate work, so naturally they do not care to spend much time in fitting themselves for teaching. They often fail to realize, however, that the same elements are necessary for success in teaching as in practical work. Among these elements are, first, a realization of what they are aiming to do for their students; second, a perspective view of their teaching work as a whole; third, a determination that, while they are at it, their work is to be teaching, and that every effort must be made to learn how to teach.

It is doubtful if the average instructor is to blame for the present situation. He graduates from college as he did from high school with a sense of the completeness of his preparation for life. He has not yet learned his limitation because he has not been "up against" any real problems. His superiors ought to help him realize what the teacher's problems are. A certain street railway company has recently installed a special track where motormen are given a chance to learn to handle a car without danger of hurting any one. The result has been a great diminution in street accidents. Professor Earle's apprentice scheme does the same in pedagogical lines. A similar result is secured in a different way in the coöperative plan as explained by Professor Faig. In last month's BULLETIN Dean Goss suggested still a third plan, namely, by the use of skilled supervision. All of these authors agree that somehow an instructor must be trained for his work.

The Minneapolis Meeting.—The decision of the Council to hold the 1913 meeting in Minneapolis will meet with general approval. It is fair to the membership generally that meetings should be held alternately East and West. Detroit, New York, Madison, Pittsburgh and Boston have been the recent meeting places, the attendance at each place being gratifying. Minneapolis offers many attractions of an engineering nature

as well as in other lines. The date of the meeting, the week of June 23, will be convenient for most members, early for some, late for others. The program will be simple with ample opportunity for discussion. Like those of last year the papers will be practical. There were questions raised then that have not yet been completely answered. There will be a chance to try to answer them at Minneapolis.

Our Membership.—President Magruder believes that, while a society membership of 1,200 shows interest in technical education, there are still at least 300 persons who are eligible to membership and who should join for their own good, for that of the schools with which they are connected and for the work which they can do best through the Society. There has been much attention given to the training of instructors. One element in such training should be participation in the activities of this society. If the Society is doing what it should, or if it can be improved so that it shall do it, it is a necessity to every engineering instructor. How can they be made to realize it? Another important class which the Society should reach is made up of trustees. A trustee certainly should know something about education if he is to be efficient. It is probable that few trustees know of the existence of the Society. At any rate, from young instructors to experienced trustees, there is a large company still outside the fold.

APPLICANTS FOR ADMISSION.

DAVIS, R. E., Instructor in Civil Engineering, University of Illinois, Urbana, Ill. 1913

HUDNUT, JOSEPH, Professor of Architecture, Alabama Polytechnic Institute, Auburn, Ala. 1913

PHILBRICK, H. S., Professor of Mechanical Engineering, Northwestern University, Evanston, Ill. 1913

READ, B. K., Instructor in Machine Design, University of Wisconsin, Madison, Wis. 1913

SCHERER, J. A. B., President of Throop Polytechnic Institute, Pasadena, Calif. 1913

SMITH, P. R., Student Instructor, General Electric Co., Pittsfield, Mass. 1913

SWAMY, BOTTA N., Overseer, Public Works, Parlakimedi, Madras, South India. 1913
TERRELL, R. C., Professor of Highway Engineering, State University of Kentucky, Frankfort, Ky. 1913
WHITEHEAD, J. B., Professor of Electrical Engineering, Johns Hopkins University, Baltimore, Md. 1913

SOCIETY BUSINESS.

President Magruder has appointed Dr. A. S. McAllister to represent the Society on the committee of the Illuminating Engineering Society devoted to illuminating engineering education.

LETTERS TO THE EDITOR.

SEC'Y S. P. E. E.

Dear Sir: I have at hand the following complete volumes of *Power*,—Vols. 27, 29, 30, 31. I do not care to keep them, yet they seem of too much value to cut up or throw away. While I presume I could not sell them, I should be willing to let anyone have them who will pay cost of transportation. Although it seems somewhat improbable that you would know of someone who would like these volumes, still I trust that you will let me know if you hear of any such person.

Yours very truly,
WINSLOW H. HERSCHEL.

UNIVERSITY OF MAINE,
ORONO, ME.

SECRETARY S. P. E. E.,

Dear Sir: President Alderson's paper on English "fills a long felt want." In the continuation of it please urge that he give his opinion on "same" used without "the" before it, in the sense of a relative pronoun, "it," "they" or "them," or instead of "the above," "the latter," etc.* Same is now the most overworked word in the language, especially in business correspondence.

Yours truly,
WM. KENT.

MONTCLAIR, N. J.,
March 4, 1913.

* N. B.—Never use "etc."

PUBLICATIONS RECEIVED.

The Iowa Engineer, Vol. XIII, No. 3. The number contains a profusely illustrated description of the engineering buildings and equipment of the Iowa State College, as well as a number of special articles on subjects of interest to the engineer.

Bulletin, Vol. I, No. 4, of the School of Mines and Metallurgy, University of Missouri. "Friction in Air Pipes," by Professor E. G. Harris.

Circular of the Bureau of Standards, No. 34. "The Relation of the Horsepower to the Kilowatt." Giving the history of the term horsepower and a clear explanation of the relation between the two units, with the statement that the ratio 746, as adopted by the A. I. E. E., is the rate of work expressed by 550 ft. lbs. per sec. at 50° latitude and sea level. The more modern practice of using the kilowatt as the unit instead of the horsepower is recommended by the Bureau of Standards.

Bulletin, Nos. 10 and 11, Williamson Free School of Mechanical Trades. Containing outlines of its Carpenters' Trade Course and of its Operating Engineers' Trade Course, for the benefit of all interested in trade instruction, or who are engaged in establishing and managing trade schools.

Bulletin, Vol. XXI, No. 57, of Throop Polytechnic Institute. "Politics as a Profession," by Henry S. Prichett, President of the Carnegie Foundation for the Advancement of Teaching. A Lecture delivered in the Extension Courses, Throop Polytechnic Institute.

Some Aspects of Vocational Guidance. A collection of articles on the subject of the title. Published by The Central Committee on Vocational Guidance, Henrietta Rodman, Chairman, Wadleigh High School, New York, N. Y.

The Index, Vol. I, No. 1. Published by the Columbus, Ohio, Trade School in its printing deparmtent. "*The Index* is presented for public favor with two objects in view,—to assist and encourage all of the boys in their academic work, and to assist and encourage the development of the Columbus Trade School." Subscription, 25 cents a year.

Clarkson Bulletin, Vol. IX, No. 4. Containing, among other items of interest, a large number of letters from graduates and the addresses of all living graduates together with their occupation.

The Boston Post, December 29, 1912. Containing an article headed "How Efficiency Standards have been Raised by Scientific Study of Motions." The article shows how, under the guidance of Mr. F. B. Gilbreth, the study of motion pictures has led to the increase of wages and of trade profits.

Quarterly of the Colorado School of Mines, Vol. VII, No. 4, Catalogue Edition.

ENGLISH: MISCELLANEOUS FAULTY EXPRESSIONS.*

BY VICTOR C. ALDERSON,

President, Colorado School of Mines.

Raise (1)—"Raise" is a vulgarism when applied to human beings, in the sense of "rear" or "bring up."

Raise (2)—"Raise" is often confused with "rise." "Raise" is the causative of "rise"; *i. e.*, "To raise" means "to cause to rise." Therefore raise must always have an object.

Raise (3)—"Raise" is a vulgarism when used as a noun.

Bad: He secured a raise of salary.

Right: He secured an increase of salary; or, his salary was raised.

Rarely ever—"Rarely ever" is a vulgarism. Use "rarely" or "hardly ever."

Bad: He rarely ever smiles.

Real—

Childish: She is real handsome.

Right: She is very handsome.

Reason—Do not complete such an expression as "the reason is" with (*a*) a "because" clause, (*b*) a "because of" phrase, (*c*) a "due to" phrase, or (*d*) an "on account of" phrase. Complete it with a "that" clause.

Bad: The reason he was offended was because they were arrogant.

Bad: The reason he was offended was because of their arrogance.

Bad: The reason he was offended was due to their arrogance.

Right: The reason he was offended was that they were arrogant.

* Concluded from February BULLETIN, p. 418.

Remember—The name of the thing remembered should not be preceded by "of."

Wrong: I remember of meeting him.

Right: I remembered meeting him.

Reverend, Honorable—These titles should be preceded by "the" and should never be followed immediately by the surname.

Wrong: Rev. Carter or, The Reverend Carter.

Right: The Reverend Mr. Carter, The Reverend Amos Carter, or The Reverend Dr. Carter.

Rig—"Rig" is a provincialism for "carriage," "buggy," or "wagon."

Right away, Right off—Use "immediately," "at once," or "directly."

Run—"Run" should not be used in the sense of "manage" or "operate."

Same (1)—"Same" is not in good use as a pronoun.

Bad: We will repair the engine and ship same to you next week.

Right: We will repair the engine and ship it to you next week.

Same (2)—"The same as" should not be used for "in the same way as" or "just as."

Wrong: The draft is treated the same as a check is treated.

Say—"Say" should not be used "to give orders" with an infinitive as object.

Crude: The guard said to go back.

Right: The guard ordered us (or told us) to go back.

Seem—"Can't seem" is a vulgarism. Use "seldom" or "hardly ever."

Seldom or ever—This is a vulgarism. Say "seldom if ever."

Set—"Set" is often confounded with "sit." "Set" is the causative of "sit"; *i. e.*, "to set" means "to cause to sit." The use of "set" without an object, as expressing mere rest, is a vulgarism; say "sit," "stand," "lie," "rest," or "is set."

Wrong: The pole sets firmly in the socket.

Right: The pole is set (or sits) firmly in the socket.

Wrong: The vase sets on the mantel.

Right: The vase stands (or rests) on the mantel.

Wrong: The boat sets lightly on the water.

Right: The boat lies (or rests) lightly on the water.

Shall, Will—A person who has not been trained to observe the proper distinction between "shall" and "will" can never be sure of using them correctly; but he will make few mistakes if he fixes firmly in his mind that—"I (or we) shall," "You will" and "He (or they) will" expresses simple futurity and that "I (or we) will," "You shall" and "He (or they) shall" imply volition on the part of the speaker.

Wrong: I will be drowned; no one shall help me.

Right: I shall be drowned; no one will help me.

Wrong: We will be smothered; say We shall be smothered.

Wrong: We will have to go; say We shall have to go.

Wrong: I am expecting a few young people to dance on Saturday and will be happy to see you on that evening.

Wrong: Where will I find the book?

Wrong: How long will we have to wait?

Shape—"Shape" is a vulgarism when used to mean "manner" or "condition."

Wrong: They executed the maneuvers in good shape.

Right: They executed the maneuvers in an expert manner.

Wrong: He is in good shape for the game.

Right: He is in good condition for the game.

Show—"Show" is a vulgarism when used (*a*) for "play," "opera," or "concert," (*b*) for "chance" or "promise."

Bad: The freshman team had an excellent show of winning.

Show up—"Show up" is a vulgarism when used intransitively in the sense of "appear," "attend," "come," or "be present."

Bad: He did not show up.

Size—Never use "size" as an adjective; say "sized" or "of size."

Right: The different sized (not size) drills.

Size up—"Size up" is a vulgarism for "estimate," "judge," or "pass upon."

So (1)—"So" should not be used for "so that."

Wrong: They strapped it so it would hold.

So (2)—Do not use "so" alone to modify an adjective.

Wrong: I was so lonely.

Right: I was very lonely.

Some—"Some" is a vulgarism when used as an adverb.

Wrong: He is some better today.

Right: He is somewhat (or a little) better today.

Start—"Start" is often used instead of "begin."

Bad: Thinking she was dead, he started to cry.

Started out—"Started out" is a crude expression for "set out," "set off," "made an excursion or trip," or "went on a journey." The verb "start" is not objectionable as applied to the beginning of a journey, but the combination of this verb without "out" should be avoided.

Stop—"Stop" means "to cease" or "cease from motion." It is a vulgarism when used in the sense of "stay."

Bad: Are you stopping with friends?

Sundown, Sunup—These are provincialisms for "sunrise" and "sunset."

Swell—"Swell" is a vulgarism when used as an adjective.

Bad: It was a swell reception.

Take—"Take" should not be used for study.

Bad: I took physics and chemistry.

Right: I studied physics and chemistry.

Take in—"Take in" is a vulgarism for "attend" or "go to."

Bad: He took in the show.

Take it—"Take it" should not be used in introducing an example.

Bad: Take it in Wisconsin, the old-fashioned method of logging is becoming extinct.

Right: In Wisconsin, for example, ...

Team—"Team" means two, or a group of persons or animals; as a "team of horses," or a "football team." It is a provincialism when applied to one animal or to a vehicle.

Than, Till, Until—These are improperly used for "when."

Right: Scarcely had he mounted the wagon when the horse started (not *than* the horse started).

Right: We had hardly got there and put things in order when Jenks came (not *till* Jenks came).

That—"That" should not be used as an adverb.

Wrong: He went only that far.

Right: He went only so far.

Wrong: If it is that bad we must retreat.

Right: If it is so bad (or so bad as that) we must retreat.

Wrong: He didn't want that much, did he?

Right: He didn't want so much as that, did he?

This—"This" should not be used as an adverb.

Wrong: Having come this far . . . .

Right: Having come thus far (or as far as this) . . . .

Wrong: The water has never been this high.

Right: The water has never been so high as this.

This here, These here, That here, Those there—These are vulgarisms for "this," "these," "that," and "those."

Through—

Wrong: He is through writing.

Right: He has finished writing.

Too, Very—Neither of these words should immediately precede a past participle: say, "too much" or "very much."

Wrong: He is too exhausted to speak.

Wrong: He felt very insulted.

Transpire—"Transpire" should not be used in the sense of "occur."

Try and—"Try and" should not be used for "try to."

Bad: I shall try and get a good position.

Tunnel, Drift—A "tunnel" is a bore that goes through a mountain, like a railroad tunnel.

Wrong: The north tunnel was advanced five feet.

Right: The north drift (or level) was advanced five feet.

Up—"Up" should not be appended to the verbs "cripple," "divide," "end," "finish," "limber," "open," "polish," "rest," "settle," "scratch," "write."

Wrong: He opened up the box and divided the money among the men.

Up to date—This is a vulgarism when used as an adjective. It is correctly used as an adverbial modifier.

Bad: His house is strictly up to date.

Right: His house is thoroughly modern.

Right: He brought the history up to date.

Value—The misuse of "value" illustrates the use of the abstract for the concrete. "Value" is an attribute like "color" or "hardness." You can no more "extract the values" than you can "extract the color."

Wrong: The vanner saved all the values in the ore.

Right: The vanner saved all the valuable minerals in the ore.

Wrong: The gold values are precipitated on zinc shavings.

Right: The gold is precipitated on zinc shavings.

Very—Avoid the excessive use of "very." "Very" can well be omitted in the following: This machine makes a very perfect separation. It is very obvious that the mine is worth the price asked for it. A very straight tunnel. The district is very prosperous, there being many very rich mines, some of which are very deep and very extensive, so that there is a very good hope of very many years of very successful development.

Vim, Snap—"Vigor," "energy," or "spirit," are to be preferred.

Wait on—"Wait on" is a vulgarism for "wait for."

Want (1)—

Wrong: I want you should be happy.

Right: I want you to be happy.

Want (2)—"Want in," "want out," "want off" are vulgarisms.

Bad: Do you want in?

Right: Do you want to come in?

Way—"Way" should not be used adverbially without a preposition governing it.

Wrong: When he acts that way . . . .

Right: When he acts in that way . . . .

Wrong: How could a sane man act the way Smith did?

Right: How could a sane man act in the way in which Smith acted? (or better) act as Smith did?

When—"When" is improperly used for "that" in sentences like the following:

Wrong: It was on a rainy day when I first saw Chicago.

Where—(1) "Where" is often misused for "that."

Wrong: I see in the morning's paper where Cronin has been caught.

Where—(2) Do not use "where to" in the sense of "whither." Omit the "to."

Bad: Where are you going to?

Which—"Which" should not be used as a relative pronoun in referring to a person.

While—"While" means (*a*) "during the time in which," (*b*) "though" or (*c*) "whereas"; as (*a*) I played while he sang; (*b*) while this may be true, it does not content me; (*c*) yours is in good condition, while mine is quite worn out. "While" should not be used loosely without regard to its meaning.

Wrong: On one side was a grove, while on the other was a river.

Right: On one side was a grove, on the other a river.

Whose—"Whose" should not be used in reference to inanimate things. Say "of which" unless the use of this expression makes the sentence extremely awkward.

Bad: Soon we came to a swamp, on whose bank stood a hunter's cabin.

Right: Soon we came to a swamp, on the bank of which stood a hunter's cabin.

Wire—Use "telegraph" or "telegram."

Would, Should—The choice between "should" and "would" is usually determined by considerations similar to those that determine the choice between "shall" and "will."

Right: If I had expected to stay at home I should not (not would not) have needed a ticket.

Right: I should (not would) be interested to know how much the mine cost.

Wrong: On this hypothesis we would expect to find ore in the third level.

Wrong: As a friend I would like to make a suggestion.

Wrong: I would be willing to hazard a guess that Professor B— can not read my writing.

Write up—Say "report," "relate," "describe," or simply "Write."

You was—"You was" is a vulgarism. Say "you were."

Active and passive verbs—The following sentences show undesirable transitions from active to passive verbs:

Wrong: These creeks flow through broad valleys until the brink of Clealum Valley is reached.

Right: These creeks flow through broad valleys until they reach the brink of Clealum Valley.

Wrong: Water absorbed at the surface percolates downward until the zone of saturation is reached.

Right: Water absorbed at the surface percolates downward until it reaches the zone of saturation.

Adverbs of time and place—Adverbs of time and place should be used carefully.

Wrong: This sandstone is sometimes gray and sometimes red in color.

Right: This sandstone in some places is gray; in other places it is red.

Since some writers find it difficult to avoid the use of words expressing time for words expressing place or number, the following list of substitutes may be helpful.

SOMETIMES—Some of; in some places or localities; in places; locally.

USUALLY—As a rule; in general; generally; commonly; for the most part; mostly; mainly; chiefly.

OFTEN—Many of; in many places; much of.

FREQUENT—Abundant; common; numerous; many.

OCCASIONALLY—Locally; in places; here and there; some of.
SELDOM, OR RARELY—Few of; in few places; generally not; little of.
NEVER—Nowhere; none of.
ALWAYS—Invariably; everywhere.

Adverbs of motion, Condition—Terms that apply to motion or action should not be used instead of terms that apply to state or condition.

Wrong: The sandstone is here suddenly replaced by limestone.

Right: The sandstone is here abruptly replaced by limestone.

Wrong: The descent on this side of the ridge is very rapid.

Right: The descent on this side of the ridge is very steep.

Qualifying adverbs—Avoid the frequent use of such qualifying adverbs as "somewhat," "probably," "perhaps," "about," and "rather." Each of the following sentences is improved by omitting the words in parenthesis.

A sampling plant was built (perhaps) five years ago.

A (somewhat) important development is announced from Cripple Creek.

The designs for an installation of any (considerable) magnitude should not be approved.

The lode is (probably about) ten feet wide.

The quartz is (rather) hard and the walls are (very) straight.

He used a solution of (about) 2 per cent. cyanide, which is (perhaps) sufficiently strong.

The mine is (about) two miles from the town.

On the whole, it is (perhaps) the largest property in the district. It is (rather) rare to see such a rich vein.

Prepositions—Prepositions are doubled badly in the following sentences:

They are, in fact, in some instances.

The cost of thawing is reported at from 9 to 12 cents a yard. This is equivalent to coal at at least $18 a ton.

The water rises to within 10 feet of the surface.

The dangling participle—A participle should not be used unless the substantive it logically modifies appears in the same sentence and is naturally and immediately connected with the participle.

Wrong: Every morning I take a run, followed by a shower bath.

Right: Every morning I take a run and immediately afterward a shower bath.

Wrong: He was deaf, caused by an early attack of scarlet fever.

Right: He was deaf as the result of an early attack of scarlet fever.

Wrong: Having come of age, I took my son into partnership with me.

Right: When my son became of age, I took him into partnership with me.

Wrong: There we landed, and having eaten our lunch, the steamboat departed.

Right: There we landed, and after we had eaten our lunch the steamboat departed.

Wrong: In talking to Smith the other day, he told me about the game.

Right: As I was talking to Smith the other day, he told me about the game.

Wrong: After flunking three times, the professor reproved me.

Right: When I had flunked three times, the professor reproved me.

The hanging participle—A sentence beginning with a participle should include the substantive to which the participle relates. The following are all bad:

Recognized as a bureau of information, the services of two men are required to answer questions.

Going westward, the dip becomes steeper.

Looking closer, glacial striate were seen.

Examined carefully, no fossils were observed.

Approaching the vein through the tunnel, the serpentine is seen to be decayed.

Not satisfied with this result, the well was drilled deeper.

When fully explored, other workable coal beds may be found here.

The possessive case—The tendency of the best modern usage is to use the preposition "of" rather than to put into the possessive case a noun that represents a thing without life.

Wrong: Civilization's march.

Right: The march of civilization.

Wrong: The catastrophe's cause.

Right: The cause of the catastrophe.

Wrong: The mine's condition.

Right: The condition of the mine.

The split infinitive—To place adverbs or adverbial phrases between "to" and the infinitive is a common fault, and although condoned by some good writers, should be avoided.

Wrong: To materially affect.

Right: To affect materially.

Wrong: To fully meet.

Right: To meet fully.

Wrong: To clearly state.

Right: To state clearly.

Wrong: To better accomplish my purpose.

Right: To accomplish my purpose better.

Wrong: It is well for me to first of all tell you why I came.

Right: It is well for me, first of all, to tell you why I came.

Superfluous words—Note the superfluous or improper words in the following phrases and sentences:

A series of broad, parallel ridges resembling in (their) form and distribution . . . .

Throughout the (entire) area . . . .

This kind of (a) deposit . . . .

This was designated (as) barren ground.

They are (both) alike.

There can be no doubt (but) that it is Cretaceous . . . .

The steamer brings freight and mail to the (different) towns in the region.

Equally (as) well.

The surveyor has not (as) yet done any work in this region.

The problem is (a) difficult (one).

This field is (located) three miles north of Boston.

Omitted words—

Wrong: He deems it no sin to steal a book or umbrella.

Right: He deems it no sin to steal a book or an umbrella.

Wrong: The style should be in harmony with the subject and sentiment.

Right: The style should be in harmony with the subject and the sentiment.

Wrong: A Golden and Boulder man were talking about the game.

Right: A Golden and a Boulder man were talking about the game.

Wrong: Had I a picture of myself, would send it to you.

Right: If I had a picture of myself: I would send it to you.

Wrong: In answer to your question regarding electric lights, would say that I find them invaluable.

Right: In answer to your question regarding electric lights, I would say that I find them invaluable.

Wrong: I forgot to do something I ought to.

Right: I forgot to do something I ought to do (or ought to have done).

Wrong: The question is one which no one has answered or ever will.

Right: The question is one which no one has answered or ever will answer.

Wrong: The Company has not and will not enter into negotiations.

Right: The Company has not entered and will not enter into negotiations.

Personal names—According to the best American practice a single initial is not used before a personal name.

Wrong: J. Smith.

Right: James Smith; J. W. Smith; or James W. Smith.

Hyphens—The use of the hyphen indicates close connection of thought without entire loss of individuality, *e. g.*,

A single-stamp mill is one containing batteries of one stamp apiece, like the Nissen stamp.

A single stamp-mill is a mill all alone.

A single-stamp-mill contains only one stamp.

A crude ore-bin is one of crude construction.

A crude-ore bin is a bin for crude ore.

Consider cooling-floor, roasting-hearth, settling-vat, zinc-box, grinding-plate.

The unnecessary plural—"Slimes," "concentrates," "fines," "tailings" and "sands" are all terms that are used by some persons only in the plural. If a mill produces more than one kind of "concentrate," or a mine produces several varieties of "ore" the plural may properly be used; not otherwise.

Wrong: They shipped ten tons of concentrates.

Right: They shipped ten tons of concentrate.

Wrong: The gravels rest upon the older schists of the region.

Right: The gravel rests upon the older schist of the region.

FUNDAMENTALS OF EDUCATION AND THE SPHERICAL-WANT SYSTEM.*

BY F. W. SPRINGER,

Professor of Electrical Engineering, University of Minnesota.

VIII.

Religion of Science.

Religion is a rather delicate subject to discuss in connection with the school problem, even in the United States, because when one says religion, most people think of creed, and immediately take on an antagonistic attitude of mind.

While any thorough study of the school problem necessitates the consideration of religion, this does not imply, however, that religion should be introduced into the public school system, as most people would understand such an innovation. Experience, as chronicled by history, is sufficient argument against introducing creeds into the public schools.

Religion is the keystone of the moral arch. The axioms of the moral code of a people are always included in its religious teachings. No nation ever existed long after it had lost its religion, even though the people continued to practice the forms of religion. Hence, **real religious training for the young is a prime necessity.**

Creed, as the form of expression of a particular religion, is essential, just as the symbols are to mathematics. But, when one confuses the form or symbol with the real thing, there results simply mental gymnastics, instead of religious feelings. The real religion a man has depends upon what kind of a man the man is, and not so much upon the form of his professed creed.

A man cannot do good work with a poor machine, and there

* Continued from February BULLETIN, p. 432.

can be no doubt but that there is a best form of creed and church for a particular race in each particular state of civilization. While religious forms are necessary to the average person, just as symbols are necessary to a mathematician, nevertheless, the best set of symbols does not necessarily imply the best mathematics. Each one believes that his respective creed or system is the best for him, and, also, for others. When a man changes his faith, those of the new consider him converted, and the others that he has been proselyted. In general, most of us are greatly concerned about our own comfort and happiness, and about the other fellow's goodness as measured by our own creed.

The particular forms of religion which any individual uses to express his religious feelings are pretty generally a matter of birth, and hence from a broad viewpoint creed must be considered as containing some prejudice, since it is generally the result of childhood environment.

Competition in creeds is as necessary in arriving at the nearest truth as is the case in science. Monopoly in religion, or rather the monopoly of its form of expression, by any one creed is just as good for a race as the monopoly in sugar, kerosene, tobacco, or steel rails. It is, no doubt, a good thing that this creed or that creed is not given the monopoly in education, and America is thus fortunate in that we have creed competition on a tolerant educational basis instead of on a belligerent one.

The public schools belong to the whole people. It is right that they should be managed by representatives of the whole people, and not in the interest of any special class or creed. However, the private class and sectarian schools, organized to do the equivalent of the work in the public schools, and something special besides, are a good thing, because if, these special schools produce a contemporaneous output that is better than that of the public schools, the necessity of improvement is evident, and hence, these private schools are an excellent stimulus to the public schools, and, like any other competition, they are to be appreciated. **The public schools are,** however,

and **should be**, the **dominating influence in education**, and they affect the special schools more than the latter do the former.

At the present time, there is quite a wide gap between the teachings of science in the schools and the teachings of religion in many of the churches and Sunday-schools. The gap is not so wide as it was, yet even now the young have difficulty in combining the two except as they believe science through reason and religion through faith, and thus accept both teachings, which are often interpreted as contradicting each other.

The only step which seems to be necessary to eliminate contradiction and leave faith in religion entirely free of scientific interference is for the churches to teach that the laws of nature, some of which are fairly explained by science, are the hands of instruments of the Power above. The knowledge of the simplicity, certainty and grandeur of these laws, as learned in school, would then increase the respect for the laws of nature or of God. Such a situation will never arrive, however, until ministers of the gospel come out more generally and state in the plainest and simplest language that the laws of nature are the laws of God, and that there is no contradiction between the **real facts** of **science** and the **tenets** of **religion.** The only possible difference would then lie between the errors of religious interpretations, and the errors in the formulation of the laws of science. Whatever is true in science is in harmony with the true religion. When such a view as the above becomes general, we may then see certain fundamental principles of religion, or of nature, not creeds, taught in the public schools in such a way as to be as acceptable to a Jew or Mohammedan as to a Christian.

That universal law of nature called the law of gravitation, for example, applies to every atom and every mass and star in the universe, without cessation. Nothing, and no one, can escape the operation or this law of nature for a moment. The Power above us is everywhere, always. There is no escape. Nature's laws can be directed, however, in the interest of man. The same laws can be used for bad as well as for good.

Whether a thing is good or bad is thus simply a question of how the forces of nature within and about us are used or directed. One directs laws of nature for good or for bad when one levels a shot gun, kicks a dog, preaches a sermon, manages a business, bolts one's food, makes a remark, and in fact, when one thinks or does anything whatsoever.

There seems to be good reason why children should be taught in school that the law of gravitation, for example, is just as divine as any other law, and there is every reason why a child should and does respect it. The same conclusion can be reached regarding other laws of science.

The introduction of religion into the schools is a difficult problem, because the moment a religious or moral curriculum is proposed it becomes a creed which would meet more or less opposition. For this reason the problem is safest in the hands of preachers at the present time.

To the Mind that knows all, that knows the amount and direction of every force and factor, there is no accident or chance. Everything in this world and elsewhere, must be according to law. Nature's laws, or God's laws, are good laws, while the laws and acts of man are good or bad according as they operate with or against those supreme forces which control the evolution of mankind.

Man's laws are man's attempt to regulate human relations in such a way as to permit the operation of nature's laws to the best average advantage to mankind. When some of man's laws are made especially for the purely selfish wants of the few, we need not be surprised that sometimes the forces of nature are misdirected. Everybody is responsible for this to the extent of his ability to understand and, certainly, in the long run the whole race is damaged by such laws.

All our instincts tell us that this life is a period for development which must be along lines laid down by nature's laws. We can only try to adapt ourselves to these laws in our own environment. Our great source of danger lies in not trying or in trying too hard; both end in elimination.

If each one could only understand, and would try to act in

accordance with the most apparent physical and mental influences or forces which affect our lives, it would seem that each one might find it possible to so apply his efforts as to be a "success." A comparatively few can. Many are weak physically or mentally by **inheritance**, by **environment**, or by direct or indirect choice, and hence fail to work in harmony with those factors which control usefulness and happiness.

Morals and Education.

Just as there is a modern trend in education, business and religion, so also is there a very evident trend in morals and moral codes. There are several factors which have to do with this movement in this country:

First, the tendency of the population to urbanize, under the influence of growth in population, scientific progress, and the resulting wealth, takes the individual out of the limelight of public sentiment which exists in the country and small towns and places the individual in a crowd where concealment is easy. In addition, the stimuli to do things in a city, are increasing with the size of cities and modern improvements. These influences are so great, and the opportunities of action so many that most people soon crave highly seasoned pleasures to satisfy their cloyed sensibilities. The competition in commercialized city pleasures and diversions forces each competitor to attract business somehow, and hence, the "advance," step by step, toward the sensational and risqué, as the city grows larger, the life more luxurious and the people less impressionable and less easily entertained.

Second, the bewildering applications of science have so speeded up modern life that the demands upon nervous energy have become very great. This results, not only in physical and mental weariness but also in a demand for the stimulus of high pressure pleasures and intoxicants. It is difficult to make a tired man laugh. The city man responds to so many stimuli that after a while he responds only to the strongest influence.

Third, the average individual yields to his environmental pressure and hence, we find a tolerance of wrongdoing in a city not possible in a smaller community.

The environment of a growing city creates demands for stronger and stronger drinks and pleasures, finally breaking down the community standards, till only corrupt public sentiment and government are possible. It becomes much worse in the second and third generations because then we have not only the corrupting environment but also the easily corrupted degenerates and other weaklings which heredity gives a race as the reward for over nervous exhaustion, bad habits, bad morals, and too much alcohol and the like.

It is generally admitted that the corrupted and corruptible already hold the balance of power in the large cities of the United States. **This element makes it possible to demand in the name of individual rights and freedom the right to corrupt or habituate the young in the interests of commercialized vice.** It is quite evident that if immorality continues with urbanization, that it is only a question of time when the liberty of the whole nation will cease to be.

One corrupting factor so increases and feeds another that after a race has gone about so far there is no coming back, because degeneration progresses at an increasing rate or by a geometrical ratio.

City life, for the above reasons, and others, demoralizes a people. Our cities grow and obtain many of the city leaders from the country, but the second generation of the new blood goes the way of city life. After a people has sufficiently urbanized, it is readily seen that it is impossible to keep up the moral strength by the country supply. Cities may be good places for adults to work in because of economic advantages, but they are bad places to live in, especially for children, because of the general failure to provide nature's environment.

The first step downward consists in doing those things one believes to be wrong, whether they are contrary to nature's laws or not, resulting in the loss of ideals, then loss of religion, although, perhaps clinging to its forms, then in doing things which are contrary to nature's laws, and then the end is in sight.

It seems to be impossible for a people to remain morally and

physically strong if removed very far from nature, and, especially when forced by the environmental pressure to form artificial tastes, as is now the case in cities. Alcohol, cigarettes and a number of other artificial stimulants and narcotics, together with the poisons resulting from excessive nerve fatigue, are always important accessories in the movement downward. Undoubtedly, **alcohol is the greatest accelerator** in acquiring habits which are contrary to the laws of nature. Social evils are always found to be bosom friends of alcohol and the liquor interests. When the third friend, the political party, representing an indifferent public, joins the group, the whole social system starts down the toboggan slide.

Besides creating bizarre tastes, urbanization increases the cost of living. This is due to the increasing percentage of distributers, advisers, suppliers of artificial tastes increase in the outlay of wealth or money and energy on public luxury, boulevards, monuments, public buildings, etc., etc., and due also to a reduced percentage of producers of necessities.

The increased cost of living, and increasing number of diversions, delay marriage. The average number of years of married life per individual is thus growing less for several reasons, besides that of delayed marriage. In the first place, the relative number of marriages is decreasing. In the second place, the average life is less for those over forty than formerly. This is due, first to the high tension of modern civilization and second, to the fact that **modern science preserves infant weaklings who, while decreasing the death rate of early life, increase it later.** Also, high tension life and immorality are producing more weaklings for science to nurse along through the educational period, when they may fall under the influence of a corrupting environment. This increases the public burden and still further increases the cost of living.

Delayed marriages, high pressure diversions, and the resulting substitutions for the normal stimuli of nature, increased cost of living, transmission of all kinds of knowledge and other

factors, have caused the birth rate to decrease by a very large percentage in the last twenty-five years.

The fewer average years of young married life, and the fewer children leave more time and desire for other things. Many wives become social parasites and merely trade marks of husbands' success. They have time to cultivate some of the foolish diversions of over-worked men. Hence, the fewer and weaker children are raised in a bad home environment. In some localities the school is the only really elevating influence, and even that is almost as much removed from the real daily life as is the church.

A great scientist and educator has said that **heredity** and **environment** determine the character of all living things and that education consists in providing an environment. It is generally admitted that the average boys are fundamentally made or unmade, in so far as their ideals and morals are concerned before fourteen. It thus appears that the method of reforming certain phases of American life, lies almost wholly in the provision of the proper home and school and community environment.

Women, as mothers, and grade school teachers, play the direct and important part in directing hereditary tendencies and fixing ideals by creating the controlling childhood environment. As the women are, so are the children very likely to be as to mental and physical habits, morals, health, and ideals. What the children are, up to the limit of their predominating mother-influences, so will the next generation and hence the race most likely become. What is good for the women is good for the children, and what is best for the children is the best for the race.

Whatever we may think of the superiority of man over woman, we must admit that if man is stronger mentally and physically and has the wider horizon, he is so because through untold generations women have selected this type as mates. Man may be lord of the present, but woman is pretty nearly the supreme controller of the future of the race because she creates or controls the environment of the children.

As long as women control the environment of children during that period in which the fundamentals of character are fixed, just so long must the race demand the highest standard of women, whatever is demanded of men. This may not be because it is fair from the individual standpoint, but because it is necessary for the good of the race. Civilization exists by faith in woman and respect for motherhood, hence, in broad terms, education has for its objects the training of girls to become good home makers and mothers, and the training of boys that they may become good providers. All vocations, politics, wars, etc., are direct or indirect means to the same end.

The home is and should be the main factor in early youth. However, modern means of transportation and communication, with their electric cars, papers, books, telephone, etc., and the stimuli of high pressure community environment are invading the home and reducing the influence of the mother over her children.

All sorts of things, both good and bad, are now within the spheres of observation of young children. The same influences are taking not only the fathers' but also many mothers' attention and time from the home and children.

Further, the **community environment is becoming more and more commercialized to the financial benefit of certain interests.** In many homes in many cities today, the brewing interests and allied "industries," for example, have greater habit-forming power upon the young at or before 14 than the home or mothers. If the reader thinks this is a bad state of affairs in this generation, let him think about the cumulative results in the second and third generations to come.

We are all creatures of habit. Our habits, good and bad, are largely dependent upon environment. Heredity in turn depends upon the environment of previous generations. The habits and character a child has, within hereditary tendencies, are determined by its environment, hence if children are subjected to a predominating modern city environment, the race is certain to degenerate. Did the reader ever size up many people whom society calls bad? There is nothing the matter

with many of these unfortunates except the habits, for which the individual is not wholly responsible.

Many things have been suggested to turn the tide of the degeneration resulting from urbanization and the advance in science. Any method to be successful must be based upon the prime motives of the race—**instincts of the mother to protect her children, self preservation, and that of men to provide for mothers and children.** These instincts are strong in the healthy races because they are the first requisites in the survival of a race. When a people loses these incentives that people dies.

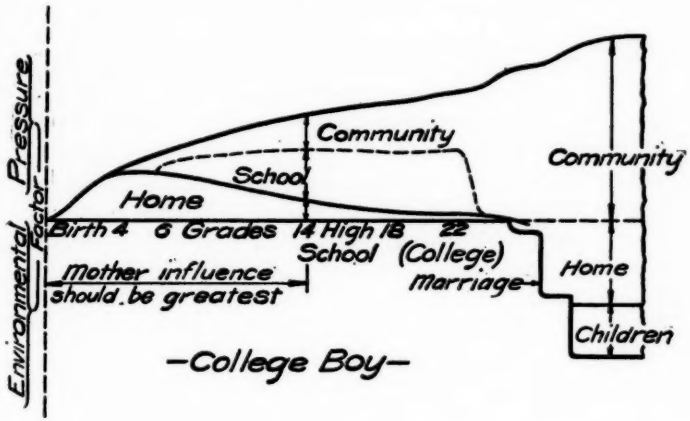
The first thing to do then is to counteract the powerful stimuli of artificial tastes and diversions in city life by strengthening the more natural and necessary instincts by education, and by replacing the harmful factors of city environment with good ones. If the saloon and public dance hall and the like are cut out, the young must be provided with some other form of activity or diversion which is good, useful, and as pleasant as possible. **The young must be kept busy.**

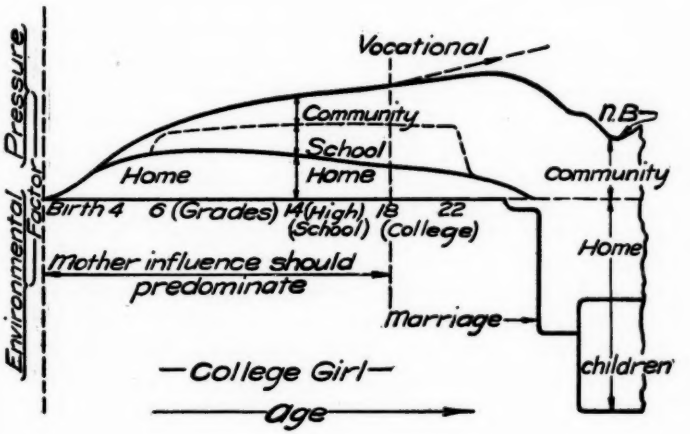
Men who have good jobs and are thereby good providers, with every prospect of remaining so, are usually not very excited about voting. Low wages or no wages make men think when they vote. It is now necessary for men to see farther ahead and have a broader horizon in order to vote intelligently, than formerly. Distance is becoming less and less a factor in politics and commerce, so that citizen-training must include instruction about other countries.

The larger percentage of women become mothers. They are or should be interested in pure-food laws and whether or not the liquor interests and police department are thick as thieves. It makes a difference to mothers whether the milk inspector is honest and efficient or not. The day of the neighborhood cow and the corner grocery and the town constable is passing. Hence, mothers, like men, must be trained to broader horizons because of the invasion of the home by community influences, or rather because of the **expansion of the home life, through modern means of communication.**

"Factors of Environmental Pressure."

The part that women can and should play in the regeneration of the race may be indicated by the accompanying diagrams in which the various factors of environmental or outside pressure are shown by the ordinates.





Women are not interested as a rule in politics, because of the stronger motives in the home, as indicated in the figure, but if mothers are shown that political control is necessary to remove a danger to children, they can be depended upon to vote in the best interests of the race. If women are to vote, the girls should, of course, receive citizenship training with the boys, under politically trained teachers, and if they do vote, it should be mainly because of the children and home.

The old argument is always in evidence that politics are so dirty that even our "best citizens" hesitate to besmirch themselves by voting, and hence it would be bad for women to mix in politics. It is a question, however, whether it would be worse for the women of the present generation running the risk of being tainted by politics now or to have the next generation of mothers spoiled because the present mothers did not vote now. Community environments will be made suitable for the children, and for the mature as well, largely by political methods. There are also other things to be done.

Citizenship training will teach boys and girls how to use, and the necessity of using, their voting power. Domestic science courses will train girls to be home makers and workers. Vocational schools will prepare boys to be good providers as soon as they reach the marriageable age, in order that those insistent instincts which make race continuation possible may not be misdirected. Natural science courses will bring the young to understand the scope and certainty of the operation of nature's laws.

It is a good thing for children to prepare and classify 100 specimens of dried flowers, and also to learn a long list of classified Latin names, to pass an examination, but it is better to understand the things themselves and the laws and conditions of plant and animal growth and propagation in order that those laws affecting the human race may be understood by inference. A boy would learn something about nature if he only planted a roasted peanut in a flower pot. He would learn more on a miniature farm of a few square feet. Boys

should be kept close to nature, and busy at something useful which they want to do—a difficult thing in a city.

If boys are taught to respect the laws of nature as instruments of the Power above, and that the same forces in nature can as readily be directed to produce bad results as good ones, and shown the good ways of using forces and opportunities about them, the moral problem would be about limited to the segregation of perverts.

We see about us every day individuals who are suffering punishment for the crimes, the carelessness, selfishness, thoughtlessness, ignorance and viciousness of their forebears. It does not matter whether the forebears were the victims of the indifference of society or not. Nature may be kind to a race by eliminating the weak and wicked and the innocent victims, but she is sometimes inexpressibly cruel, from man's standpoint, to the individual. Yet nature often seems to forgive grave infractions of her laws, especially with the assistance of competent physicians, providing, however, that the transgressor reforms, otherwise never. Somebody pays. It is generally the innocent second generation and the race in general. Alcohol and similar things would be beneficial because they kill off the weak and weak willed, if their effects were confined to the one generation. They are not.

There is every reason why it should be understood by the young that the misuse of any of nature's laws is inevitably followed by disastrous results. Such results are as sure as those following a disregard of the laws of gravitation.

Between the ages of fourteen and eighteen the inexorable laws of nature, including the laws of health, the laws of survival of the fittest, the penalties which second generations pay for the mistakes, ignorance, carelessness, viciousness and crimes of the first generation, all should be taught in graded steps, so that at eighteen all boys and girls may know their duties to themselves, and to those that are to follow. Pride in race may be developed by teaching rational eugenics, but this should not mean sex algebra to children.

Modern facilities make it so easy to learn some things in a way they should not be shown to the young, that it becomes more and more necessary to use the same means for transmitting information in the right way,—and to do it first. A proper training would help young men to see that it is their duty to themselves and to the race to avoid those things which prevent the rational and normal operation of racial instincts.

A young woman who has learned in the right way the price she pays for selecting a mistake for a mate, will on the average pass up the undesirables, even for intimate friendships. Similarly, the young men will not present themselves for selection to undesirable girls and the result will be that heredity, through eugenics, will have a chance to bring up the qualities of the race.

Those classes which do not reproduce themselves, such as some of American rich, need not be considered, except as they create good or bad examples and environment for others.

The criminals may be segregated or treated in other ways beyond the scope of this paper.

By all the force of simple justice, every child is entitled first to the right to healthy parents who wanted him, and second, the child has the right to that preparation at the hands of the state which shall give him a fair start in the life of the state under a favorable environment. When the young learn that it is the greatest thing in life to raise fine babies, and that it is almost the sole absolutely necessary thing for the perpetuation of the race, then there will not be much trouble solving many other things. Such a conception of life would give an attitude of mind and a sense of responsibility which would be a splendid start on other problems.

A good pilot knows the safe course, not where all the rocks lie. It is not necessary to tell boys all the tricks of immorality, in order that they avoid them. They should know some things in the right way at the right time, and for the right reason, because, if they are not told in the proper way they will find it very easy to learn the wrong way.

We are all ready for a fall at some time or other. If a

railing is around the coal hole in the walk we are less liable to fall into it. If cigarettes and alcohol which kill the initiative and will power of a boy are not sold, if saloons are not open, etc., etc., he does not think about them. One must think and act to form habits, good or bad.

If a boy must sow wild oats, it had best be after he reaches his manhood sphere and fully understands the consequences to himself and to those to come after him, and before he has a family dependent upon him.

If boys are allowed to go into the larger sphere of life and are thrown into temptation beyond their sphere of knowledge, or ability to understand, many will fall. Many bad habits are acquired by inexperienced boys through the desire of some enterprises to make money. One doesn't suppose that it would make the average saloon-keeper awfully mad if he knew that boys wanted to learn to drink so as to become men the quicker. For every consumer that dies, **business** demands a new one and stands ready to fight for several new ones.

Man's laws of society are thus often perverted by special interests to obtain special privileges for the few, without regard to the many. While the laws of society or state guide one in relations with fellow-men, and public opinion or the sheriff bring us back if we go astray, physical and mental pain summon us if we offend nature's laws. We must acknowledge the authority of both the state and nature, because there is, in the long run, no escape from either, and **yet,** in many cases, it is impossible to obey both. It is thus the duty of every one to see that our laws are not inconsistent with nature's laws. But, no matter how good the laws, or what school system or scheme of life is in operation, nature will always find some way of eliminating the weak, weak-willed and wicked. No system will make everybody happy. The strong will thrive and rule, and the weak and wicked, together with their victims, will die.

Paternalism and coddling may enable the weak to survive, but this can only delay the operation of the laws of elimination, increase the burden on the strong and increase the number to be eventually marked for an early demise. **But, there**

would be fewer weak to die young, if there were fewer weaklings born, or if fewer strong children were made weak or bad by bad training or by the lack of good training.

No man is a good citizen who does not stand for a square deal for others as well as for himself, and who is not active in directing and assisting the laws of nature to develop a strong race.

COLLEGE NEWS.

University of Illinois.—On February 6, 7 and 8, in the electrical laboratory, the students of the department of electrical engineering gave their triennial electrical show. Although under student management, it was by no means wholly a student show, as many manufacturing and sales companies in the electrical trade offered exhibits. Among the exhibits were: Isolated lighting plants, heating and cooking accessories, telephone, telegraph, and wireless apparatus, lifting magnets, motor controllers, high frequency machinery, and a complete electrically operated café. Student demonstrators or manufacturers' representatives were in charge of each exhibit. One special feature was an exhibit of all types and methods of electrical lighting, in charge of students of electrical illumination who discussed with visitors the best and cheapest ways of lighting their buildings. Under the general direction of Dr. E. J. Berg, head of the department of electrical engineering, a business organization composed of graduate and undergraduate students carried on the entire work incident to the show.

Throop Polytechnic Institute.—Throop Polytechnic Institute opened last September, with an enlarged faculty and with an enrollment thirty-three per cent. larger than that of last year. While the attendance is still not large, an increase from an enrollment of thirty-eight to fifty students is very gratifying to the trustees and faculty.—Additions to the staff in the department of chemistry are indicative of the desire of the Institute to meet a local demand, especially along the lines of petroleum technology. Dr. Richard S. Curtiss, formerly professor of organic chemistry in the University of Illinois, who came to the Institute this year as professor of organic chemistry and research associate, is giving special attention to this line of work. Dr. Charles A. Brautlecht, who received his

Ph.D., from Yale last June, is now instructor in the department of chemistry. In order to make possible the extension of the work in this department, two large additional research laboratories, a balance room, dark room and an extra stock room were provided and equipped with the necessary apparatus and facilities, and the new work is progressing successfully.—The increase in students made necessary additional instruction in modern languages, and Mr. Cornelius Jansen, B.A., University of Nebraska, was appointed instructor in this department. The work of the Institute in all departments is moving along satisfactorily, and indications point to the completion of the most successful year in the history of the new Institute.

Columbia University.—A series of lectures on topics related to highway construction has been given before the graduate students in highway engineering. Among the speakers have been: Mr. Arthur N. Johnson, M. Am. Soc. C. E., state highway engineer of Illinois, who lectured on "Cement-Concrete Highway Bridges"; Mr. Francis P. Smith, M. Am. Soc. C. E., chemical and consulting paving engineer, who lectured on "The Mining and Refining of Asphaltic Oils"; Mr. Walter H. Fulweiler, Assoc. M. Am. Soc. C. E., engineer, research department, United Gas Improvement Company, Philadelphia, who lectured on the "Manufacture of Refined Water Gas-Tar"; Mr. Philip P. Sharples, chief chemist, Barrett Manufacturing Company, Boston, who lectured on the "Manufacture of Refined Coal-Tar"; Mr. Harold Parker, M. Am. Soc. C. E., first vice-president, Hassam Paving Company, Worcester, Mass., who lectured on "Specifications Covering Patented Pavements"; Mr. Clifford Richardson, M. Am. Soc. C. E., consulting engineer, who lectured on "The Economics of Highway Construction."

Worcester Polytechnic Institute.—The department of mechanical engineering has installed a new testing machine, with a capacity of 50,000 lbs., equipped with dial screw beam, and all latest appliances for accuracy and convenience. It is

operated by a reversing induction motor. The equipment of the Institute testing laboratory is now very complete, including a 400,000 lbs. Olsen testing machine, a 100,000 Olsen testing machine, a 22,500 Wicksteed and a 100,000 Emery. The department is under the direction of Prof. J. H. Nelson, professor of applied mechanics, and Mr. F. W. Roys, instructor in mechanical engineering.—During the last summer Professor Nelson conducted tests on various forms of partition walls for the department of public safety of Cleveland, Ohio. These were the first tests of this kind ever conducted in this country and some interesting results were obtained.

At the last meeting of the Mechanical Engineering Society the speaker was Mr. J. N. Heald, '85, general manager and treasurer of the Heald Machine Co., of Worcester, Mass. His subject was "Engineering and Shop Management."

The library of the department of civil engineering has recently acquired a complete set of the *Proceedings of the American Railway and Bridge Building Association.*

Mr. W. W. Monroe has become instructor in pattern-making in place of Mr. W. R. Tilden, who has resigned to accept a position in Elizabeth, N. J. Mr. Monroe comes from the Holyoke Machine Co., of Worcester, Mass.

The junior class in civil engineering took an inspection trip to Boston, recently. Most of the time was spent at the South Terminal, where especial attention was paid to the ice making, gas and compressed air plants, the large signaling apparatus in the central tower, the yard tracks and the underground loop. Later an inspection was made of the new Boylston Street tunnel.

By the will of Mrs. Harriet D. Brown, the Institute becomes the residuary legatee of her estate, as well as the beneficiary of a bequest. The total amount will be about $50,000, and the money is to be used for scholarships. This is an especially opportune gift to the Institute as it will enable scholarships to be given to students from outside the State. At present there are about 70 scholarships available, but all save one or two must go to residents of the State or of Worcester county.

University of Maine.—A new course in telephone engineering is offered in the department of electrical engineering this semester. The course is given by Mr. Nash, a graduate of the University of Illinois.—Dean H. S. Boardman of the College of Technology and Professors C. B. Brown, P. L. Bean and J. E. Kaulfuss of the Department of Civil Engineering, attended the annual convention of the Maine Society of Civil Engineers, which was held in the State House, Augusta, Feb. 10th and 11th. Dean Boardman was elected president of the Society for the ensuing year. The committee on good roads, of which Prof. Kaulfuss is a member, made an exhaustive report on the work that has been done on Maine roads and the possibilities of future improvement.

Lehigh University.—By the will of the late John Fritz, of Bethlehem, Pa., who died on February 13th, the university is made the residuary legatee, and will probably receive about $150,000, for the maintenance of the fine engineering laboratory recently given to the university by Mr. Fritz at a cost of about $300,000. Mr. Fritz has been a trustee of the university ever since its founding in 1865. It has also recently been announced that Mr. Charles L. Taylor would give to Lehigh a new gymnasium and stadium, to cost about $200,000. Mr. Taylor is an alumnus of Lehigh, and was associated in the steel industry with Mr. Andrew Carnegie.

SECTION II.

PAPERS FORMING A PART OF THE PROCEEDINGS OF THE SOCIETY.

THE TRAINING OF ENGINEERING TEACHERS.*

BY GARDNER C. ANTHONY,
Dean of the Engineering School, Tufts College.

The long-continued controversy between the adherents of a classical training on the one hand and a technical, or vocational, training on the other is evidence of the importance which educators have placed on subject matter; but it seems to me that we are nearing the end of that period and are coming to recognize the importance of the object as well as the subject matter of our labors. We know that the tools for the creation of art must be largely dependent on the material to be worked, and that we may produce as great art by the chisel and hammer as by the brush, and that neither is of value save as directed by the trained mind. So too, our labors must be directed toward the development of men of ideals regardless of the schools, or tools of thought.

If each one of you were asked to name the influences which have helped to make you what you are, the answer would not be in terms of subject matter but of men, and most frequently quite distinct from the subject matter. Granting this to be true, I would ask: What are we doing to assist each other; what service are we rendering our less experienced colleagues in the development of those characteristics which will fit them for responsibilities far greater than that of imparting information, namely, that of becoming living witnesses of the ideals they teach?

The subject matter of this symposium, "The Training of Teachers," is so closely allied to that of efficiency in education as to make it supplementary to it, but I fancy that our

* Introductory remarks by Chairman Anthony at the session of the Boston Convention of the S. P. E. E. devoted to "The Training of Teachers."

special field will be that of the consideration of the methods of helping each other by such means as supervision, coördination of courses, faculty seminars, a more systematic training in the shop and field by summer work, and a recognition of the broader view which must be taken when we remember the ideals that we wish to have realized in our successors. That such a discussion may be made profitable, it is of much importance that we should get the point of view of those who have just entered the field of education and whose criticism should be of great value, even though some suggestions may be regarded as impractical and contrary to the preconceived ideas of teaching.

First among the questions which this subject suggests is,—the effort, if any, that we are making to humanize teachers that they may become leaders rather than pushers of men. A teacher need not be popular in the ordinary social acceptance of that term, but he must command the respect of his class for ability and fair play, with never a suggestion of a revengeful spirit, but as a living example of his ideals outside of, as well as within, the class room. But how may we learn of these needs or render assistance to those suddenly thrust into this field of labor, unless supervision of some sort be maintained, and what is the condition and attitude of our colleges with respect to supervision? In the BULLETIN for May, 1912, I called attention to an article in the *Pedagogical Seminary* for December, 1911, by Dr. Samuel P. Capen, because it is the first investigation of the sort that I know to have been made, and in order to bring the importance of this home to us, I shall briefly quote from the article. He says, "A few years ago the superintendent of schools in a middle-western city visited all the courses in liberal arts at one of the large eastern universities. He spent several weeks in the task and graded the work of all instructors according to the standards which he commonly applies in judging his own corps of teachers. His marking showed that, judged by these standards, about sixty per cent. of the professors and instructors were too poor to keep. About twenty-five per cent. were passably good, but

should be urged to give more attention to the methods of presenting their respective subjects. About fifteen per cent. were excellent." Believing that the efficiency test, which is now a common subject of investigation in colleges, should begin here, Dr. Capen undertook to find out the practice of sixty representative institutions. As the promotion of members of college faculties should be largely dependent on some form of supervision or investigation, it is rather startling to learn that but thirty-seven of the institutions investigated have any such supervision deserving of the name, and that more than one-half believe that supervision is undesirable or that it would be resented.

Another point that I hope may be discussed here is that of the period for beginning the profession of teaching. I believe it unfortunate for the graduates of a college or technical school to begin teaching immediately after graduation, and extremely hazardous to allow one to teach at first in the institution from which he has graduated. If the business of teaching is that of dispensing facts, my point is not worth your consideration, but if you are looking for teachers who will develop the ideals which we all cherish, the teacher must know more of mankind than can possibly be derived from life as an undergraduate or a graduate student. He should have a perspective of the real life of men to protect him from the narrowing vocation of a college teacher in which there is less probability of his coming into active conflict with broader minds and the living problems of today.

Again, what are we doing to help the man who has entered the profession of teaching with the handicap just mentioned? How many institutions have adopted systems for the transfer of these men to several departments, or enabled the young instructor, acting in the capacity of observer, assistant, or may I not say apprentice, to have the opportunity of being associated with several experienced instructors? In the English department at Tufts we have made a very successful trial of this latter scheme concerning which we will hear from the head of that department to-night.

One of the most important phases of this subject which must be reckoned with in order to produce the highest type of teacher, is that of coördination. The time has passed when any teacher, however great, may teach apart from his colleagues with success to himself, his college, or his students,—a custom which I fancy was largely the product of an elective system. We must become more and more a unit in the correlation of college work, and this, too, without in any way impairing the efficiency of the instructor by limiting his independence and restraining the development of the individual. The common practice of placing an inexperienced teacher in charge of a class and permitting him to drift, until by chance in the course of years, he discovers his inefficiency, is a wrong to the individual, the student, and the institution.

Finally, to what extent do we recognize the great influence of the teacher in the development of character, which counts for more than all else in the education of our college men? Is anything done to improve the character of this influence? Do we, indeed, know much about these qualities of our associates. And, if we do, are we serving them by systematic, timely and kindly advice?

THE EFFECT OF COOPERATIVE COURSES UPON INSTRUCTORS.*

BY JOHN T. FAIG,

Professor of Mechanical Engineering, University of Cincinnati.

So radical a departure as the coöperative courses from the established systems of engineering instruction could not fail to have some effect upon the teachers and the teaching of cooperative students. The officers of your society, realizing this, requested a paper on the subject. The writer has taught at the University of Cincinnati for the past six years, covering the period during which the coöperative courses, originated by Dean Schneider, have been in operation there. His experience in teaching students in regular four-year courses includes two universities besides the University of Cincinnati. This paper refers to instructors in technical subjects, though others, for instance instructors in economics, are affected.

The following explanation may make the paper more easily understood. The coöperative courses include mechanical, electrical, civil and chemical engineering, named in the order of their development. Mechanical engineering coöperates with many firms, which may be broadly divided into machine-tool shops and power-machinery shops. A consulting mechanical engineer's office and a mechanical-specialties agency are also included. Besides the electrical shops, electrical engineering coöperates with the local telephone and traction companies. Civil engineering coöperates with the railroads about Cincinnati and in other sections of the country; with the city of Cincinnati in the Department of Public Service, which includes work in highways, bridges, inspection, water works and sewers; and with firms engaged in fabricating and

* Presented at the session of the Boston Convention of the S. P. E. E. devoted to "The Training of Teachers."

construction. Chemical engineering coördinates with a number of manufacturers of chemical supplies; with steel works and foundries; and with the testing department of the city. The firms employing coöperative students are nearly all located in Cincinnati, though some students work in Covington and Newport, Kentucky; Norwood, Middletown and Cleveland, Ohio; and Mattoon, Illinois. Plans for next year contemplate a still wider geographical distribution of students.

The influences of coöperative courses upon instructors are due to causes which may be broadly divided into three classes.

1. The types of the industries, together with their physical equipment and methods, affect the schedule of studies and the matter which is offered in each subject.

2. The engineers, business executives, superintendents and foremen of coöperating industries influence instructors by suggestions and reports of progress of students.

3. The coöperative students influence instructors by requests for information relating to operations or methods coming under their notice; by the interest shown in certain subjects and requests for other subjects; by intimate knowledge of certain processes and methods, and by their reflection of the general attitude of workmen employed by their firms.

These influences are interdependent and are given in the order of the effects on instructors and not in the order of their importance. The writer is inclined to believe that the influence of the students themselves is the greatest.

The influences upon instructors under heading (1) may be thus briefly outlined. Schedules of studies for coöperative courses were prepared after a study of those industries of the vicinity that offered coöperation and of those that were likely to offer coöperation later. These schedules were based upon strong courses in the fundamentals and were prepared by the heads of the departments mentioned. The usual shop-practice courses and some purely descriptive courses were dropped. Syllabi of the technical subjects offered by the various instructors were frankly discussed and the matter defined. Syllabi of non-technical courses, such as elementary chemistry,

elementary physics, preliminary and applied mathematics, were also discussed. The study of the syllabi was intended to properly coördinate the work within the University.

The development of the schedules of studies and syllabi of subjects has been a matter of years and deserves more than passing mention. The original schedules of studies were based upon those for the four-year courses, with some modifications. The extent to which the coöperation with shops would facilitate teaching of technical subjects could only be estimated at that time. As the first group of students advanced and other groups took their places, the experience of the instructors suggested modifications of the schedules, which were made each year. The study of the preliminary mathematics and applied mathematics syllabi was made in order that these subjects might be coördinated with each other and later with applied mathematics in electricity, thermodynamics, structural engineering, etc. The syllabi of physics were studied to coördinate them with class-room and laboratory work in electricity and thermodynamics. The coördination within the University has been developed to a high degree. Instructors in English assist in this coördination by criticisms of laboratory reports, reports of inspection trips and theses. For example, when an inspection trip is made, the object of which is the study of coal and ash handling machinery, the reports are graded by an instructor in engineering and returned. The students then submit them to an instructor in English, who criticizes the descriptions, arrangement of matter and clearness of expression. Such work, of course, composes only part of the instruction given in English. For the reason that the coöperative courses are a departure from the established systems of teaching engineering, every traditional method of teaching and even every subject was questioned.

The development of the schedules and syllabi has been continuous and has demanded much time and thought. They have developed with the instructors' knowledge of the industries and their daily contact with coöperative students, and

have effectually prevented their getting into ruts. In general, the applications of theory are drawn largely from coördinating shops. For example, applied thermodynamics at Cincinnati coördinates mainly with steam and gas machinery, to a lesser extent with air machinery and least of all with refrigeration machinery. The illustrations and problems deal largely with the first two classes of machinery. In another location the manufacture of air and refrigerating machinery might be leading industries and the illustrations and problems would deal largely with that class of work. In either case, a sound training in fundamentals can be given, but the class-work will be vitalized by illustrations that appeal to some students particularly, and that lead to illuminating questions and discussions. The opportunity for closer coöordination between each student and his shopwork comes in practical problems and design.

The influence of the equipment and product of coöperating firms is to turn the laboratory instructor aside from the conventional lines of work, such as laboratory tests of materials, capacity and efficiency tests of power machines. These have their uses and it is necessary for every student to conduct such tests, particularly if his work is with a firm producing machinery of another class. The greater number of engineering graduates, however, find their employment outside of the production or superintendence of steam, gas, air and refrigerating machinery. There are other classes of machinery just as deserving of study, where the improvements to be made are greater because of the fact that they have never been carefully studied. This occasionally results in apparatus being loaned to the laboratories for investigation by students, or placed at the disposal of students in the factories. The interest attaching to such investigations, the rewards for which, to the student, are immediate and apparent, will be understood. One instance of this class of machinery is that used in the grinding of inks. Such machines were originally designed by ink manufacturers and built by machinery firms upon contract. From time to time improvements were made, but the highest development

did not occur, because the ink manufacturer is rarely a designer and the designer for the machine firm knows little of the actual conditions of ink manufacture. An investigation by a coöperative student, under the guidance of an instructor, led to a change of speeds that resulted in a greatly increased output, and indicated lines for further investigation that will undoubtedly decrease the present cost of production.

The same firm has asked that a coöperative student in its employ be permitted to study the drying of certain materials with a view to reducing the time and cost of production. The interest of both instructor and student in such work, which must usually be done under working conditions at the factories, can be understood. In tests of materials, students are encouraged to provide their own specimens from the shops, which relieves the department of some expense and arouses interest in a class of experiments that are certainly not of an exciting nature. Any student has the right to submit a specimen for test at any time, and it will be tested free of cost in a regular laboratory period.

There is no question of the vitalizing action of coöperation upon courses in design. That such courses tend to become stereotyped is a matter of general experience. Many students conceive ideas that they are anxious to reduce to tangible form on paper. The latter part of courses in design is largely composed of problems suggested by students. As an example, the following may be cited. In a certain course after preliminary fundamental exercises, students were asked to suggest their own problems. One student suggested the design of a simple device for rapid and accurate hand-reaming. This had no relation to the course of design he was taking, but he was given the permission. The need for such a device in his shop and the saving that could be effected by it were explained by him. His interest in this problem was greater than in any other of the course and the care taken was greater, because of the fact that the machine will eventually be put into service.

Occasionally such problems run outside the usual experience of an instructor. The writer was startled by a request for

information on the theory of dough mixers and cracker machines. This student was put in touch with instructors who could tell him something of the chemistry of bread making and give him proper references. He was given the opportunity to observe the operation of such machines in large bakeries and advised that he would be supplied with necessary instruments for such tests as he cared to make, if he could secure the machines and the dough.

The advantage to instructors of the contact with business executives, superintendents and foremen will be easily understood. The acquaintances and friendships formed, often give the instructors access to valuable data. Discussions of the aptitude of the students for their work give the instructors hints as to the matter that should be included in, or eliminated from, the course. In several instances, instructors have been attracted by superior advantages offered them by industries of the city. None of these advantages is peculiar to the cooperative courses, but the writer believes they are secured to a greater degree in them, other things being equal.

It will of course be evident that the questions of students are largely colored by their shop experience. By shop experience is meant not only the actual processes in which the student has been engaged, but the power equipment, heating, lighting, transmission, cost systems, etc., that come under his notice. The effect of their experience on questions asked during recitations in metallurgy, shop production, mechanism, design, steam and gas engineering, and the illustrations that instructors may draw from such questions will be evident. Each student gets the benefit of the experience of every other student in his class. The knowledge of shop methods and labor conditions gained by many students leads to discussions that give instructors much clearer ideas of actual conditions than can ordinarily be secured by them. In one of the meetings of the Cincinnati Student Branch of the A. S. M. E., two students presented a paper on "Scientific Time-Setting." They had been engaged in this work under experts for many months, had fixed the time for many operations in the machin-

ing of parts in large lots and had first-hand knowledge of the wage increase effected and the reception given the system by the workmen. The discussion which followed was vigorous and from the heart, and gave a far better idea of the temper of men working under such conditions than could be obtained from the usual discussions of production engineers.

In the study of steam engineering, students present steam and air cards of machines in their shops, combined cards of compound engines and two-stage compressors, Zeuner diagrams of various gears and partial or completed designs for shop tools and power machines for discussion. The writer was surprised to have two electrical students, coöperating with the local telephone company, demand admission into a class in gas engineering. They had observed many gas engines about telephone plants and added this subject to their schedule, though it had not been contemplated.

Thesis problems often grow out of the experience of the students in the shops, many of which need to be worked out in the factories. Among the requests for such assignments on file with the writer at present are the following: The drying of inks with hot air; a study of the hardening of steel in the furnaces of one of the factories; a study of the humidifying of air in a certain heating system and the effect of opening doors and windows on the plenum system of ventilation; a study of the fundamentals of time-setting for milling, planer and lathe work, access being given to the records of many years; a combination of the power plants of the Cincinnati Work-house and House of Refuge to reduce operating expenses; a study of the entire rearrangement of the equipment of a factory to secure increased production. Coöperative firms which conduct investigations or make tests for themselves almost invariably use coöperative students to direct or assist in the work.

The general operation of coöperative courses aims to introduce students to the least interesting shopwork first, in other words to give them "the practical end of the business," referred to by Mr. E. B. Raymond in the BULLETIN for October,

1911. Students to whom this is irksome, or who are temperamentally unfitted for such work, drop out or change to a more congenial course. The effect is to relieve the institutions of the graduating of unfit men. Practically all of the elimination takes place in the first year. Students who fail at one place are given a new trial and are often entirely successful in another class of work. The experience of students in shops, guides them in the selection of the course to be pursued and changes of courses are facilitated where it is evident that the bent of a student is in a different direction. The responsibility of instructors for the selection of courses is thus decreased, and advice, when asked, can be given with a better understanding of the conditions.

It is a matter of common experience that the environment of students affects their mental attitudes. Such an effect was expected when the coöperative courses were started, though just what the effect would be was not known.

A student in a shop is given an order to do a certain thing with explicit instructions as to how to do it. In his earlier years he is required (and this is especially true in machine shops) to follow his instructions implicitly. Very little is left to his initiative, although good judgment is always necessary. Nor is it usually wise for him to go beyond his instructions. In other words, he does just what he is told to do, no more and no less. When he comes to the University, he expects the same detailed instructions for work in the class-room that he has had in the shop and is inclined to criticize subject matter and methods of instruction, particularly if he does not see their relation to his shopwork.

In order to counteract this tendency, the coöperative student is given the least possible amount of instruction in procedure, especially in his laboratory work. In addition, he is given practical problems in chemistry, design and the laboratories, in which each problem is clearly stated and he is left to find the line of attack. When he has outlined a method of procedure, the instructor discusses it with him, and he is left to follow it out. For example, in the latter part of his first

year, he is told to make a pound of baking soda, or he asks permission to find if a certain water is suitable for boiler use. No instructions are given. At first he feels lost and wanders aimlessly; he gropes through books for ideas or references, gets a hint here and there and finally learns the procedure.

Without these changes in our pedagogical method the coöperative student would tend to lose his power of initiative,—a very valuable asset to the engineer. But we are enabled by the changes that have been inaugurated, to counteract this tendency, and at the same time to preserve the other valuable asset to the engineer which the coöperative student obtains from this very training, namely, the ability to carry out instructions implicitly and accurately. It will be evident, however, that these two absolutely opposite systems, the shop system of detailed instructions with implicit obedience, and the university system of meagre instruction with demanded performance, cause a student to be very critical of his teachers at times, believing it unfair to be held to complete performance without complete instructions.

Such effects of environment on students in coöperative courses as the one just outlined have necessitated an amount of analysis and discussion out of all proportion to that usually given to the arrangement and the development of methods for the teaching of regular students. Faculty meetings of the College of Engineering are held each week, in which every instructor has a voice. Discussions are informal and frank, the traditional methods being constantly analyzed in the light of experience with coöperative students, and new methods proposed and discussed. The result has been to energize the work of instructors to the highest degree.

The number and variety of firms coöperating with the University of Cincinnati is increasing from year to year and it appears that this will continue for some time. The effects of coöperation upon instructors will increase, particularly since the present tendency is for the coördination during the latter years of the courses to fall more directly into the technical departments than was possible during the period of inception

and development of the courses. The writer regrets that the instances given in his paper relate almost entirely to one department. He is free to admit that different instructors may note different effects from coöperation, and fully expects to modify his views with further experience.

THE FACULTY SEMINAR.

BY HENRY H. NORRIS,

Professor of Electrical Engineering, Cornell University.

The teacher of technical subjects has two important features of his work to consider. On the one hand his teaching, to be safe, must be based on practical experience; on the other, it must be in accord with sound pedagogical principles. Engineering subjects cannot be successfully bought with practice as the dominating idea. There is, however, considerable danger of getting too far from practice and making the instruction "bookish." The pedagogue is a poor technical teacher. With these facts in mind an experiment has been conducted for a few years back in the electrical engineering department of Sibley College, designed to bring to the attention of the teachers the fundamentals of their craft. At the request of Chairman Anthony a brief account of this experiment will be given.

For some years the teachers in the department have been meeting weekly to discuss topics of common interest. They decided to learn some of the lessons of teaching by resolving the meeting into a class taught by one of their number. A topic was selected from the regular curriculum and the class endeavored to impersonate the students to whom the lesson would ordinarily be taught. The teacher took, say, a half hour in presenting the lesson, teaching it as he would to his students. After this the time was occupied in criticism of the method of teaching employed and in discussion of the general principles involved. As it was understood in advance that no offense was to be taken at criticism, good feeling always prevailed in the discussion.

An endeavor was made to have the experimental teaching bring out some special feature, such as attracting and holding

attention, getting the point of contact, insuring maximum mental activity on the part of the student, etc. Thus emphasis was placed on the fact that the purpose of the lesson is not primarily to impart facts but to produce a certain effect upon the student's mental attitude and habits.

In connection with these exercises it developed that among the teachers some were less fully prepared on the foundation principles of their subjects than they should have been. A natural development of the seminar was then to take up the science of electrical engineering and to discuss the elements in much more detail than they could be taken up in regular classes. This practice has been found very beneficial.

In order to make the methods of conducting the seminar more tangible, a few extracts from the minutes of two of the meetings are given below. Such minutes have been kept regularly and they assist in conserving the results of the work and in giving continuity to it.

Minutes of a Sample Meeting Devoted to Details of Instruction.

Prof. ——— gave a summary of the course of instruction in electrical engineering followed by the junior class up to the date of the meeting. The meeting then resolved itself into a class of juniors and Mr. ——— conducted a recitation on the electric circuit.

Discussion: Mr. ———. It seemed to me that the idea that inductance is the number of lines of force per ampere was not sufficiently emphasized.

Prof. ———. You mean not lines but lines times turns or linkages.

Mr. ———. All right, only don't begin your instruction with di/dt. A student can get a physical concept of N/I more easily.

Mr. ———. The instructor did not answer immediately the questions asked by the students. I think that he should do so. He also gave too many formulas at one time.

Prof. ———. The aim of the instruction is to cover the general case first. This may take longer at the start but time is saved in the end.

Mr. ———. The instructor tried to bring out separate points by separate questions. It would be better to take the students into your confidence and bring out just what happens physically. Then let the explanation come out naturally.

Mr. ———. Is it always advisable to bring out everything by questions in a recitation?

Prof. ———. I do not think so although some teachers advise it. In this course a certain amount of ground must be covered and we do not have time to bring out everything by questions.

The matter of separating good and poor students, especially in laboratory work, was then taken up. Prof. ———, of the University of Missouri, who happened to be present, stated that in that institution the students were placed in sections in accordance with their previous records. In this way the slow students got more than they otherwise would have done and the good students were not held back. An instructor formerly at Purdue stated that there the custom was to appoint section leaders for all experiments one term in advance, a report for an experiment being required only from the leader of that experiment. In that way the work of preparing reports was reduced and all of the benefits to the students were retained.

Minutes of a Sample Meeting Devoted to an Important General Problem.

The presidential address delivered by Prof. A. N. Talbot, of the University of Illinois, at the Pittsburgh meeting of the Society for the Promotion of Engineering Education was read by the secretary of the meeting.

Discussion: Mr. ———. What was the point in the paper about the instructors taking graduate work?

Prof. ———. The speaker referred to the taking of graduate work by instructors as preparation for the teaching of engineering subjects.

Mr. ———. Does he advocate doing the graduate work previous to or during the teaching period?

Prof. ———. Previous to it, but better during the teaching period than not at all. The position of the engineering teacher is peculiar in that he does not, as a rule, look upon teaching as his life work. It is somewhat similar to the attitude of women in the industries. It is probable that the greater part of the teaching must be done in this way.

Mr. ———. Is not this of necessity rather than choice? A man must have a salary upon which he can live.

Prof. ———. A teacher's salary, of course, will never be as high as for commercial work of the same grade, but there are compensating advantages which must be considered.

Mr. ———. The chances of advancement outside should also be considered.

Prof. ———. There is always a chance for a man in teaching to take work outside if he is prepared for it.

Mr. ———. Teaching is often very monotonous. The explanation of the same facts day after day throughout the year sometimes gets on the instructor's nerves.

Prof. ———. One remedy for that is a shifting of work for the teachers, transferring them from one course to another before the first becomes wearisome. The distribution of the administrative work among the teachers also tends to reduce the monotony.

Some objection has been raised to the teacher training plan which has been described in that it may tend to make the instruction artificial. If one teacher is impelled to imitate another in method or manner such will be the case. If the work is well conducted it should not result in artificiality. It is true that, like other arts, that of teaching can only be learned by exercise. The practical work in this line usually has to be done in the classroom. It seems reasonable to transfer a part of the learning process to a special class comprising only teachers. Here all can be drilled in the underlying principals of their specialties and can at the same time have practice in the art of teaching.

TRAINING TEACHERS BY APPRENTICESHIP.*

BY SAMUEL C. EARLE,
Professor of Engineering English, Tufts College.

There are two classes of teachers that are liable to prove inefficient. The first includes all those who as yet have had no experience as teachers; the second includes all those who have already had such experience. In contributing to this evening's discussion, I shall say a few words as to the causes and the results of failures in each case; and I shall also venture to suggest a method of training which is, if not preventive, at least palliative. I have been asked to read a paper on this subject not because there is anything particularly original in the idea, but because it was felt that the training of teachers by apprenticeship deserves more general attention than it has yet received.

I.

In these days of scientific shop management, no one will assume that a man is fitted to be "boss" merely because he has himself successfully operated the machines. In addition to machinery, we realize that he should know men and management, and should have acquaintance with the general conditions under which work is carried on in his particular shop. If an inexperienced man must be put in charge, it is an elementary principle of efficiency that he should be given opportunity to learn his new duties and should be required to study his specific problem of management as assiduously as he devoted himself to learning the operation of machinery.

Now between studying in class and teaching there is at least as great difference. A would-be teacher may have done high grade work in calculus or in precise surveying, but the

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college requires not a mathematician or a surveyor but a *teacher*. Yet colleges, in those cases where they find it necessary to hire inexperienced men, do not hesitate to take youths on evidence that they have been good students, without making adequate provision for their learning to teach. The optimism with which we accept the idea that the right sort will win out in the end often blinds us to the wretched economy of allowing them to blunder into mastery.

Let me use as an illustration, a single case of a man who was transferred directly from studying to teaching. The college where he was engaged was distinctly different from the one in which he had studied, in the character of its student body, in its faculty, in its methods, even in its aims, so that he was in a way blinded to the real nature of the difficulties before him. For six years he had planned to teach one subject; he was now asked to teach another. For three years he had been in small classes of graduate students; he must now teach large classes of freshmen. College training had meant to him general education; yet the work he was engaged to perform was the teaching of engineers, concerning whom, as undergraduates or as graduates, he had little more exact knowledge than "the man in the street." Yet he was set to work without definite directions or advice and without opportunity to study the methods of others; and was allowed to continue without criticism or oversight of any sort. His excuse for taking the position was that it was the only one he could get in the locality to which he felt for the time bound; but what could have been the excuse of those who hired him? This case may be extreme. I know it is true, for I was the man; and I believe there are many other cases which may differ from it in quantity, so to speak, but not in quality.

The result of that foolishness which rushes in where angels fear to tread may be that the young man is not reappointed. More frequently he is continued. In either case we seem persistently to close our eyes to the fact that not only during his first year but for many years during which he or others are

blindly experimenting, the work is done with far less than a reasonable degree of efficiency.

Such inefficiency is serious in three ways: In its effects on the students, on the instructor himself, and on the work of the college as a whole. The ordinary student will do his work as he will, or will refuse to do it at all when a ball game or a rough-house is more interesting; but this same man is full of resentment if he does not receive the best instruction and the most considerate attention from each of his instructors. These are his inalienable rights, for has he not paid his $225 per year, his $150, or it may be $35? We teachers may be well aware that the poorest of his instructors is putting more devotion into the work than he, and that the course costs at worst much more than he is paying. Nevertheless, should we not sympathize with the student attitude? The inefficient instructor may be replaced another year, but to the student, college is like life, he passes that way but once. Why should he be singled out to serve as raw material for a blundering beginner to practice on, with all the possible serious results? If each man in the class had the spirit of the real student and said to himself, "I will learn in spite of the instructor," all would be well; but that were asking a young man to be more than human. Instead, he takes the unfortunate situation as sufficient justification for neglect and failure, and at times for exercising devilish ingenuity in making a bad matter worse.

As for the instructor, failure may compel him to tear up roots which he has already sent down very deep; it may even —I have known such cases—force him out of a profession which is his ardent first choice. The most serious result, however, in these cases and in those as well which are not outwardly failures is the wound to self respect. The man may be able to look you in the face and explain that he has accepted a much better position, or he may gain reappointment and escape being publicly pilloried; but nothing rankles worse than the realization of failure. Now, no man you would engage would undertake to teach for revenue only; no one

who has mastered even one subject sufficiently to be hired is a fool. There are failures, temporary if not permanent (how many we have not yet begun to realize, because of our present uncertain standards of efficiency); but the great majority are due, I believe, not to the teachers themselves, but to their superiors. *Instructors are not given proper opportunity to learn their trade.* Every time a teacher is dropped—at least after the expiration of his first appointment—because of inefficiency, it reflects seriously on the institution and the injury to the school is far-reaching; but to allow a teacher even to start on the road to failure for lack of systematic and sympathetic guidance, works a more irreparable wrong on the teacher himself. For our fellow-mortals, the jaded nags straining over the city pavements, you engineers are substituting the gasoline engine, which combines with freedom from nerves the power to avenge any mistreatment; but you have not and cannot change the fact that your employees, whether at the loom or behind the instructor's desk, are, first and foremost, human beings. So long as you pay them as you do at present, you are largely dependent upon unpaid loyalty, and should do everything possible to help them win success.

There remains to be considered the injury to the institution as a whole. The bungling of a new teacher upsets, to some extent, the whole process. Instruction not acquired by the student at one point may cripple the work at many other points; habits of neglect formed anywhere, weaken the power of application everywhere; and dissatisfaction with the work of only a few hours per week is canker at the heart of that loyalty without which no college training can be really successful. We seldom realize this as we should, for we have not yet learned the meaning of coördination—that in all the work of any school there should be singleness of purpose and thorough coöperation—nor do we fully appreciate the fact that for the student, education is but one process. Since I am a teacher myself and lamentably human, the human problem of the individual employees seems to me the most serious; if I were a stockholder or a corporation manager, a dean or a

president, I should feel, perhaps, that no employee who fails, deserves much sympathy, but that the crippling of the plant through the inefficiency of any one of its units is a fatal defect.

II.

Until a teacher has properly learned his trade, he labors under the difficulties of the beginner; and, however long he may have taught in one place, if he changes to another, he must, in important ways, make a fresh start. But experienced teachers are also liable to become inefficient, and this may happen long before they are old enough to be relegated to the shelter of the Carnegie Foundation. If it is the hookworm, as we are told, that causes laziness, there are many of us who do not go barefooted who would at times in the year gladly take the cure. But in my experience weariness of the flesh is far less frequently the cause of inefficiency among experienced teachers of engineers than ambition. Ambition to know something about one's subject, to do research work, to write books, to be of service in the community, to do collateral work for practical experience or for reputation, and alas! more frequently still, ambition to earn enough outside the classroom to pay for the privilege of teaching in college. All of these are strong temptations to cut down the time and the enthusiasm actually given to teaching. Nowhere, that I think of, is it easier for a man to drop in efficiency either from inertia or from ambition. The teacher may travel year after year along the old groove, needing to give but a glance at the subject at the beginning of the class hour. There is no one to detect the routine character of his class work or to appreciate the venerability of his jokes—unless the students buy second-hand text-books with pencil annotations, and even if they do, the teacher does not know that he is detected till too late. Even with more careful supervision from those above him than most college teachers are favored with, it is easy to trust the class work to the inspiration of the moment, and who is there day by day to instruct the instructor?

III.

In schools all over the country, attempts are being made to increase the efficiency of both these classes of teachers. I shall give a brief suggestion of *one method only*. For the past few years we have been trying an experiment in apprenticeship. By that I mean that we hire young men just graduated from college and require them to serve a year not as an instructor but distinctly as an assistant. They have charge of no classes or divisions, but are required to attend all meetings of the subjects which they are to teach later on. From the middle to the end of the year the assistant is given opportunity here and there to work naturally and under careful guidance into charge of classes. From the first he has written work to criticize, he holds as many hours of conferences with students as he has time for, and outside of the class-room he is given a chance, as proctor of a dormitory, to become intimately acquainted with the students.

This apprenticeship gives the beginner important advantages:

1. He is enabled to review from a new point all the subjects he is to teach.

2. He has opportunity to study in detail methods of presenting his subjects.

3. He can profit by the accumulated experience of his predecessors.

4. He can, far more thoroughly and accurately than if he were teacher himself, observe the actual results of instruction on the students.

5. He can become partially initiated under guidance before he risks failure, and can gain the friendship and confidence of the students before he is led to offend them by inadvertence.

6. Though he receives small pay the advantages are more than enough to compensate.

This same means offers equally great advantages to the older teacher:

1. He has a friendly critic, more mature than the students, watching him at all times in class.

2. He can gain from this critic, and through him from the students, suggestions which are extremely helpful and which he could get in no other way.

3. He is compelled, in order to carry out the system satisfactorily, to hold regular departmental meetings in which the future work is carefully planned and the results of past work discussed. By this means he can combine with whatever mature experience the older men may have, the originality, the fresh enthusiasm, and the appreciation of the student point of view of the younger men.

4. He maintains more intimate friendly relations in his department and with the students.

5. Though he may have to do some extra instructing himself, he receives enough assistance in the routine work and enough inspiration to recompense.

I confess that my personal knowledge of the working of this system of apprenticeship is limited to the department of English. I recognize that in some other departments it might be more difficult to apply such a method of training without increasing the cost. In general, however, it may be said that in any department which includes three or more teachers there is certain to be enough work that may be classed as "assistance" to occupy one man's time, and that consequently it is but a matter of management to give that work from year to year to low-priced men, thereby saving the time of the higher-priced men. And it should be obviously good economy—though many persistently refuse to recognize the fact—when the amount of money available is narrowly limited, to insist on buying good instruction as long as the money lasts, rather than to pretend to do more when the instruction must be less efficient. I make, therefore, the following suggestions:

1. That no inexperienced man should be allowed charge of classes till he has served an apprenticeship which will adequately prepare him to teach.

2. That even experienced teachers should be given, whenever they are asked to undertake work under new conditions, full opportunity to study those conditions.

3. That as far as possible the older teachers should be given the advantage of friendly criticism of their class work by younger men.

4. That each department of instruction should be organized for careful study of methods and results of teaching so as to conserve the benefits of past experience and to add those of fresh thought.

The fundamental principles of scientific management as formulated by Mr. Frederick W. Taylor, you will remember, are these: (1) The development of a true science, (2) the scientific selection of the workman, (3) his scientific education and development, and (4) the intimate friendly coöperation between management and the men. I do not think I need to point out that such a system of apprenticeship as I have suggested gives the opportunity to accomplish just these objects in the college. As far as my experience goes, it is not only an effective means of training the individual teacher but the best means of developing and maintaining coöperation among teachers, coördination of the work of instruction, the loyalty of the younger members of the faculty, and friendly understanding between students and faculty.